A SUMMARY OF INFORMATION RELATED TO THE COMPREHENSIVE MANAGEMENT OF GROUNDWATER RESOURCES IN MADISON, MONROE, AND ST. CLAIR COUNTIES, ILLINOIS

By

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Groundwater has become valuable as a water source throughout the three-county area, serving as a supply for public, industrial, domestic and agricultural uses. This report summarizes and interprets available information related to its occurrence, movement, availability, use and quality in the three counties. Information in this report is intended to serve as the bases for development of a regional strategy for the comprehensive, long-term management of the area's groundwater resource and to identify present or potential problem areas with respect to its use and/or quality.

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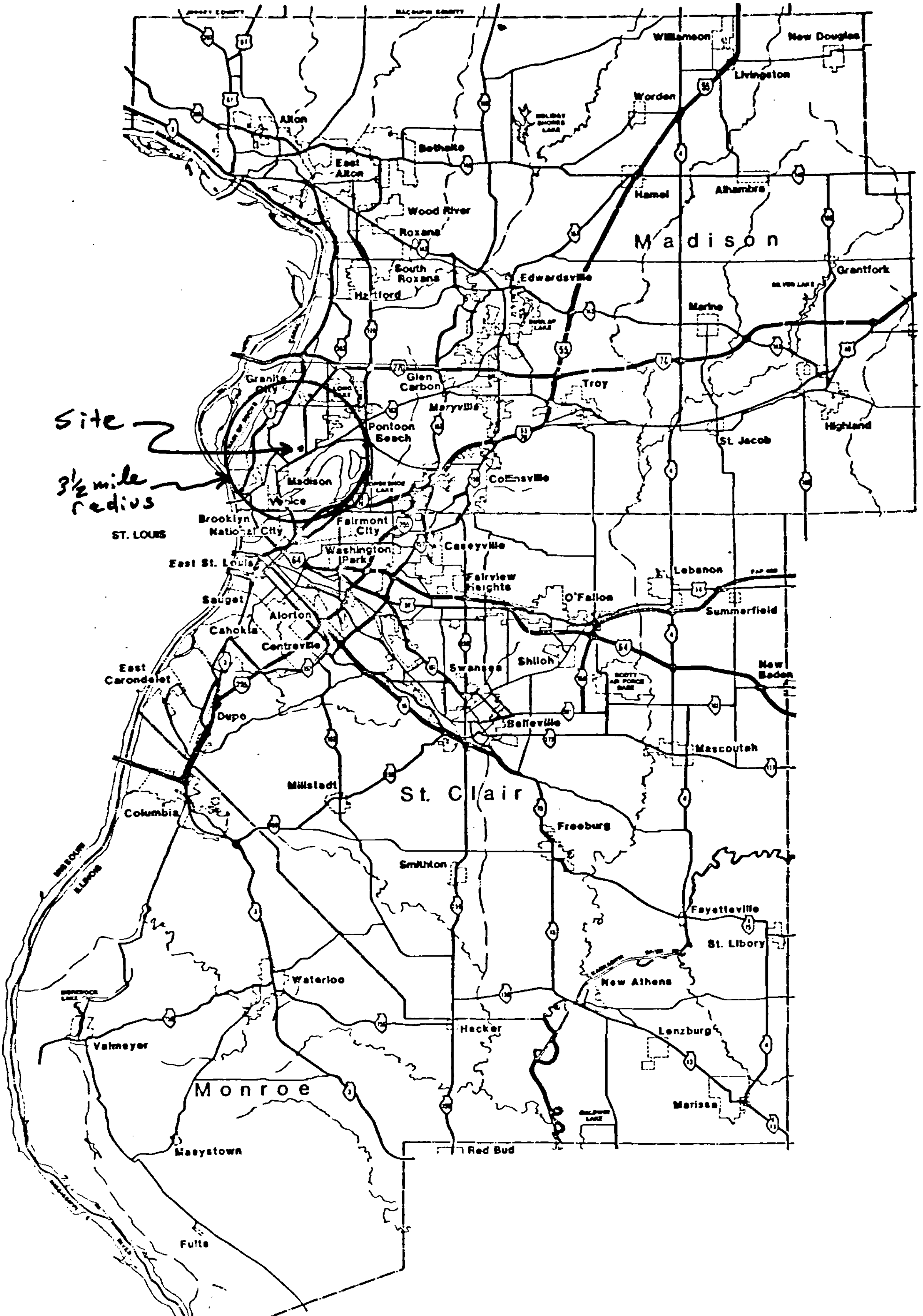

Site
3½ mile radius
Madison
St. Clair
Monroe
ST. LOUIS
Alton
East Alton
Bethalto
Wood River
Roxana
South Roxana
Hartford
Edwardsville
Williamson
New Douglas
Livingston
Worden
Hamel
Alhambra
Grantfork
Marine
Granite City
Glen Carbon
Troy
Maryville
Pontoon Beach
Collinsville
St. Jacob
Highland
Madison
Venice
Brooklyn
National City
Fairmont City
Washington Park
Caseyville
East St. Louis
Fairview Heights
Lebanon
O'Fallon
Summerfield
Sauget
Alorton
Cahokia
Centreville
Swansea
Shiloh
New Baden
East Carondelet
Dupo
Belleville
Mascoutah
Millstadt
Columbia
Freeburg
Smithton
Fayetteville
St. Libory
Waterloo
New Athens
Valmeyer
Hecker
Lenzburg
Marissa
Maeystown
Red Bud
Fults

I. INTRODUCTION

Groundwater is a vitally important natural resource that, until recent years, has been taken for granted and given little protection. Natural underground reservoirs (aquifers) vary greatly in the quantity of water available for use. Where present and capable of supplying water they have many advantages over surface water sources. They are readily available for storing water without any expenditures for construction purposes. They have large capacities and don't become clogged with silt and weeds as do lakes. Relatively inexpensive to tap, underground reservoirs lose little or no water by evaporation, they can supply water over large areas without the necessity of building canals, pipelines, or distribution systems; and, if properly managed, their period of usefulness has no foreseeable limit for all practical purposes.

Dependability is another major benefit of groundwater as a source of supply. Droughts and dry spells that lower levels in streams and lakes seldom have any substantial impact on groundwater reservoirs. Even though natural recharge through the soil is reduced or even halted during such periods, large amounts of water are usually present in the groundwater bank, where they serve as a reserve to tide the well owner over until the rains come again. In addition, because groundwater is insulated and protected below the surface of the earth, it is usually far less subject to contamination and pollution than the water in rivers and lakes.

Despite the fact that most groundwater aquifers have a natural protective barrier, instances of contamination of groundwater used for public and private drinking water supplies have been reported throughout the country. The critical aspect of groundwater pollution is that, once contaminated it may be decades before it can be used due to its very slow movement and limited mixing. Unlike surface water, groundwater quality cannot be "corrected" by applying pollution control measures after the pollution has occurred. Cleanup is difficult and costly -- sometimes impossible. In addition, monitoring groundwater quality is a difficult task. Not only because wells must be dug, but because the lack of mixing in an aquifer dictates that several samples from different locations and levels are needed to get an accurate picture of groundwater quality in an area.

Uses of Groundwater in Madison, St. Clair and Monroe Counties

Groundwater has become valuable as a water source throughout the three-county area, serving as a supply for public, industrial, domestic and agricultural uses. The area's major aquifers are located in the American Bottoms (also known as the Mississippi River flood plain), the lowland area which lies between the Mississippi River and the bluffs along the western edge of the study region. In addition to being the area's largest groundwater source, it is also the location of major concentrations of urbanization and industrialization.

Within the three counties, thirty-three (33) separate public water supply systems obtain water from ground sources. Twenty (20) of these systems are for municipalities (see Table 1) while the remaining thirteen (13) systems supply areas such as mobile home parks, schools, and industry. These twenty systems use approximately 10.3 million gallons per day (mgd) to supply an estimated 120,919 persons. The largest withdrawals are made in the American Bottoms area to serve the larger population in that area with the smaller withdrawals being made for the communities in the eastern section of the upland.

Industry is a major user of groundwater in the American Bottoms (see Chapter III). Although industrial pumpage has decreased in recent years it still serves as a valuable resource. A major advantage of groundwater is that it maintains an almost constant temperature throughout the year. Industries, as a result, are able to utilize the groundwater for cooling water during the summer months when the Mississippi River water is warm. In addition, the cost of treating the groundwater is lower than treating Mississippi River water which is heavily laden with sediment and chemicals.

Groundwater is also used for domestic and irrigation purposes but in relatively small amounts. For most rural areas, however, groundwater represents the only economical source of water. Rural water users are greatly dispersed. It would be economically prohibitive to design and develop a water system which could supply relatively few users over an extensive area. Therefore, rural residents are often totally dependent upon groundwater. Groundwater for irrigation accounts for a very small portion of total groundwater usage, approximately one percent. Most of the irrigation wells are located in the American Bottoms and are used primarily to irrigate horseradish and truck crops. The amount of groundwater pumped depends in large part on climatic conditions. In years with significantly below normal precipitation there is a substantial increase in the amount of groundwater pumpage.

The potential for polluting groundwater is high in many portions of the study area. This is particularly true within the American Bottoms and major flood plains throughout the region. Within these lowland areas, groundwater levels are generally high and therefore more susceptible to pollution from solid and liquid waste disposal. Major sources of potential groundwater pollution within the three-county area are identified in the following chapters.

Purpose and Scope

The purpose of this report is to summarize and interpret available information related to groundwater occurrence, movement, availability, use,

Table 1

LOCATION OF GROUNDWATER SOURCES FOR COMMUNITIES OF MADISON, ST. CLAIR AND MONROE COUNTIES

Community	Estimated Population Served	Average Daily Withdrawals (MGD)	Location of Groundwater Source: American Bottoms	Location of Groundwater Source: Other Than the American Bottoms
MADISON COUNTY:				
Alhambra	825	0.060		X
Bethalto	18,239	1.380		X
Collinsville	23,698	2.150	X	
East Alton	7,800	0.650	X	
Edwardsville	26,993	1.790	X	
Glen Carbon	5,310	0.530	X	
Hamel	600	0.059		X
Hartford	1,680	0.360	X	
Holiday (MHP)	600	0.027	X	
Livingston	967	0.057		X
Marine	1,004	0.074		X
Maryville	3,393	0.299	X	
Roxana	3,886	0.580	X	
St. Jacob	862	0.057		X
Troy	9,245	0.681	X	
Wood River	13,500	1.327	X	
Worden	950	0.060		X
Subtotal	119,552	10.141		
ST. CLAIR COUNTY:				
Fayetteville	380	0.024		X
Mounds (PWD)	2,200	0.108	X	
St. Libory	550	0.057		X
Subtotal	3,130	0.189		
MONROE COUNTY:				
Valmeyer	900	0.075		X
Maeystown	137	0.011		X
Maple Leaf Estates	42	0.005		X
Timber Lake Estates	75	0.005		X
Subtotal	1,154	0.096		
TOTAL	123,836	10.426		

Source: IEPA, Division of Public Water Supplies, Collinsville Field Office, 1983.

landform, located in northeastern Madison County, western St. Clair County and central part of Monroe County, is dotted by several small communities, many of which serve as agricultural trade centers.

Soils - The four major topographic features, discussed above, readily correspond to the region's three major soil classifications: bottomland, terrace and upland soils.

Bottomland soils consist primarily of nearly level to gently sloping silty clay, silt loam, and silty clay loam; terrace soils of nearly level to strongly sloping silt loam, silty clay loam, and assorted sandy soils; and upland soils of nearly level to very steep silt loam and loam soils.

Detailed soil surveys have been completed for the study area. This information is available in each of the three counties from the respective Soil and Water Conservation Districts.

Socio-Economic Characteristics

Population - The population of the three-county study area is primarily urban oriented, with an estimated 80 percent of the area's 535,339 residents living in the highly urbanized western portion of the area.

The Counties of Madison and St. Clair contain the largest urban concentrations. Eighty-four percent of the 515,000 people living in these two counties in 1980 reside in urban areas. Monroe County has approximately 20,000 residents with only 45 percent in urban areas.

Both Madison and St. Clair County showed a loss of approximately 21,000 residents during the 1970-80 decade while Monroe County showed an increase of approximately 1,200 residents.

The most recent population projections prepared by the Illinois Bureau of the Budget (IBOB) project a total increase of only 26,458 residents or 5 percent in the 3-county study area by the year 2000. Percent of increase by county is 0.2 in Madison County; 8.7 in St. Clair County; and 12.9 in Monroe County.

Land Use - The study area offers a wide diversity of land use types, from the industrial complexes in western Madison and St. Clair Counties to the agricultural lands in the eastern portions of these counties and in Monroe County. Urbanized centers within the region range in size from small outlying communities of less than 500 to conglomerate urbanized areas with populations exceeding 125,000. National rail and highway networks converge in the American Bottoms at the heavy industrial-urban complexes of Alton-Wood River, the Tri-Cities and East St. Louis.

Approximately 146 square miles, or 18 percent of the 1,792-square mile region are presently in urban uses. Eighty-one percent of this developed area is comprised of residential uses and 19 percent industrial concerns and commercial establishments. Heavy industry (steel mills, oil refineries, meat packing, chemical industries and metal fabricating) is located on the western edge of St. Clair and Madison Counties in the American Bottoms. Light industries are scattered throughout the counties with the largest concentrations located in the Cities of Belleville and Highland. Commercial development is scattered throughout the area with regional shopping centers at Fairview Heights and Alton.

The remaining 1,646 square miles or 92 percent of the total study area includes farmland (909 square miles or 51 percent is in crops), woodland and miscellaneous uses. In these rural areas general agriculture provides the chief source of income.

Based on the 1980 population trends, urbanization is expected to continue along the upland corridor from Belleville to Edwardsville.

Hydrometeorologic Conditions

The Southwestern Illinois region experiences a continental climate characterized by hot, humid summers and mild winters punctuated by extremely cold periods of short duration. The three-county study area of Madison, St. Clair and Monroe Counties is situated in a major frontal zone resulting from the convergence of warm moist air from the Gulf of Mexico and cold, dry air from Canada. This frontal zone produces a variety of weather conditions which are subject to rapid changes.

Precipitation - The 80-year average precipitation for the region is 35.4 inches per year. In the last 25 years the average has been 39.5 inches. June is normally the wettest month and has an average of 4.3 inches of rain. Thunderstorms produce much of the summer rainfall and also are responsible for the unusually heavy rains which may result in isolated flooding. Long-term records show monthly precipitation maximums of 10 and 11 inches to be rather rare during the summer months. A few daily precipitation maximums of 3 and 4 inches occur during the most severe summer thunderstorms. Rainstorms that produce 1 to 2 inches of precipitation in a few hours are rather common.

During the summer months, the mid-day relative humidity ranges between 50 and 60 percent with early morning readings near saturation. Heavy dews are common on clear calm nights.

Winter humidity is 10 to 15 percent higher when maritime tropical air from the Gulf moves in at temperatures just below freezing. Snow may occur in any or all months from early November through April. Average annual snowfall is approximately 17 inches. Most snowstorms produce less than 5 inches of snow but maximum depths of 10 to 12 inches do occur in the most

III. GROUNDWATER QUANTITY

Geohydrology

Bedrock - The bedrock underlying Southwestern Illinois consists of Cambria, Ordivician, Silurian, Devonian, Mississippian, and Pennsylvanian sedimentary rocks (i.e., sandstone, shale, dolomite, and limestone) resting on crystalline basement rocks composed mainly of granite. Tilting and folding of the bedrock surface resulted in the present bedrock surface topography shown in Figure 2 and the distribution of the uppermost bedrock units as shown in Figure 3.

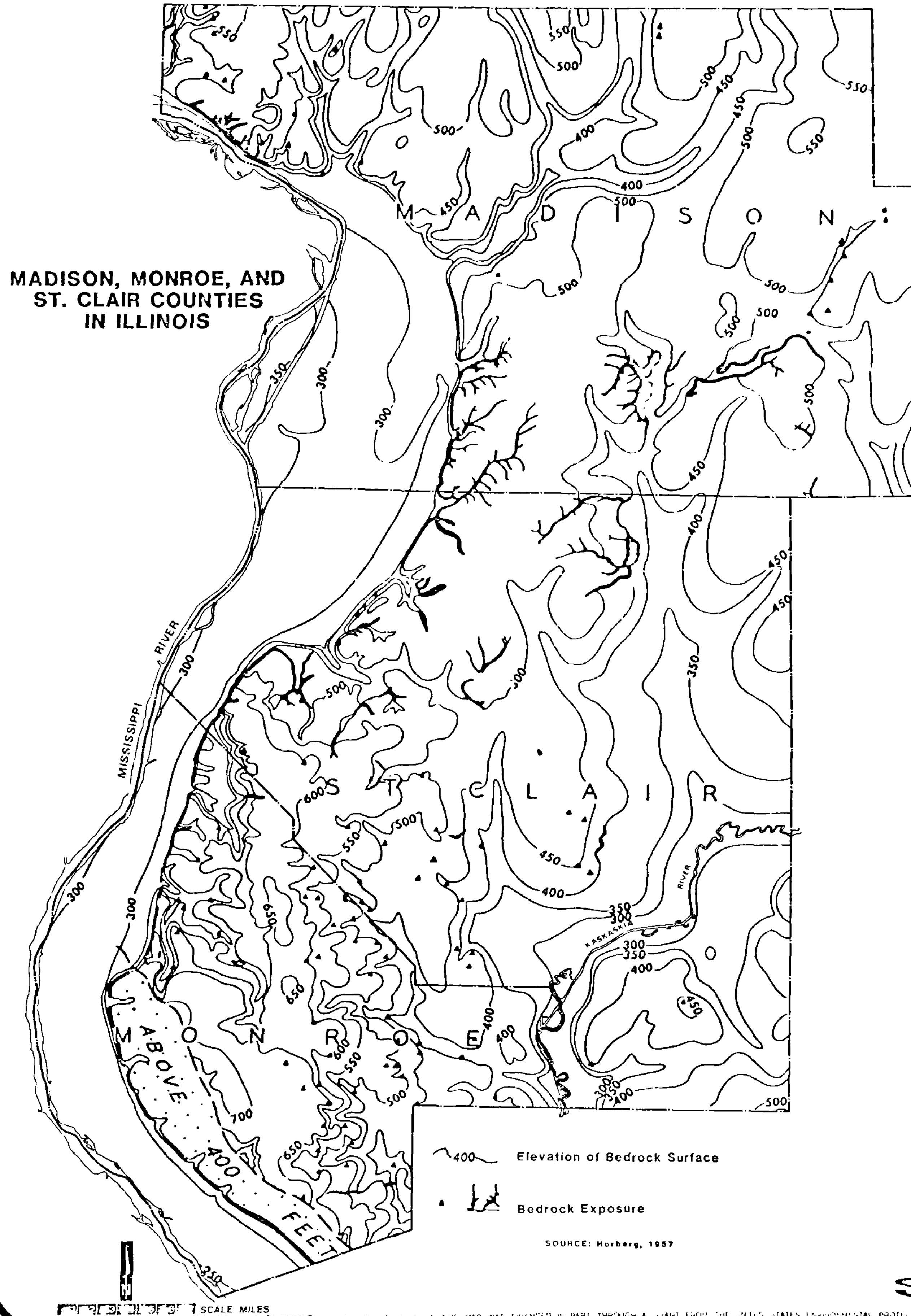
The Ordivician rocks, which consist mainly of limestone and dolomite with minor quantities of sandstone, are found only beneath a small portion of the American Bottoms in Monroe County. The Ordivician system dips sharply eastward toward a geologic depression known as the Illinois Basin and is thus found at much greater depths throughout the remainder of the three counties. The Ordivician limestone and dolomite formations are potential sources of groundwater but have not been exploited due to the excellent possibilities in the shallow sand and gravel aquifers.

The Silurian and Devonian bedrock lies under younger bedrock formations throughout the study area. Consisting of limestone and dolomite, the rocks may yield groundwater from joints and channels but the water is too deep and highly mineralized to be considered as potential sources of groundwater supply.

Mississippian rocks, composed of limestone, sandstone and shale, are prevalent throughout most of the western portion of the study area. Mississippian limestones and sandstones are suitable sources of groundwater supply for small to medium uses where they are present immediately below the unconsolidated material or where they are covered by thin Pennsylvanian formations. This bedrock aquifer is of little significance in the American Bottoms where the shallow sand and gravel aquifer offers an abundance of groundwater. Mississippian rocks in the extreme western uplands are fine-grained and cherty limestones in which abundant sinkholes occur forming Karst topography. Karst is a term used to describe a condition in which soluble limestone or dolomite has been partially dissolved as a result of chemical actions induced by water passing through carbonate rock. When sizeable quantities of rock have been dissolved, the land surface often subsides as a result of the lack of supporting bedrock. The surface depressions created are known as sinkholes and usually lead directly to caverns containing underground streams. Because of the damage of pollution in wells that penetrate shallow cavernous limestone, wells in this formation must be constructed with special attention to sanitary practices.

The Pennsylvanian rocks, found directly below the glacial drift in the central and eastern portions of the study area, have relatively low

Bedrock Topography



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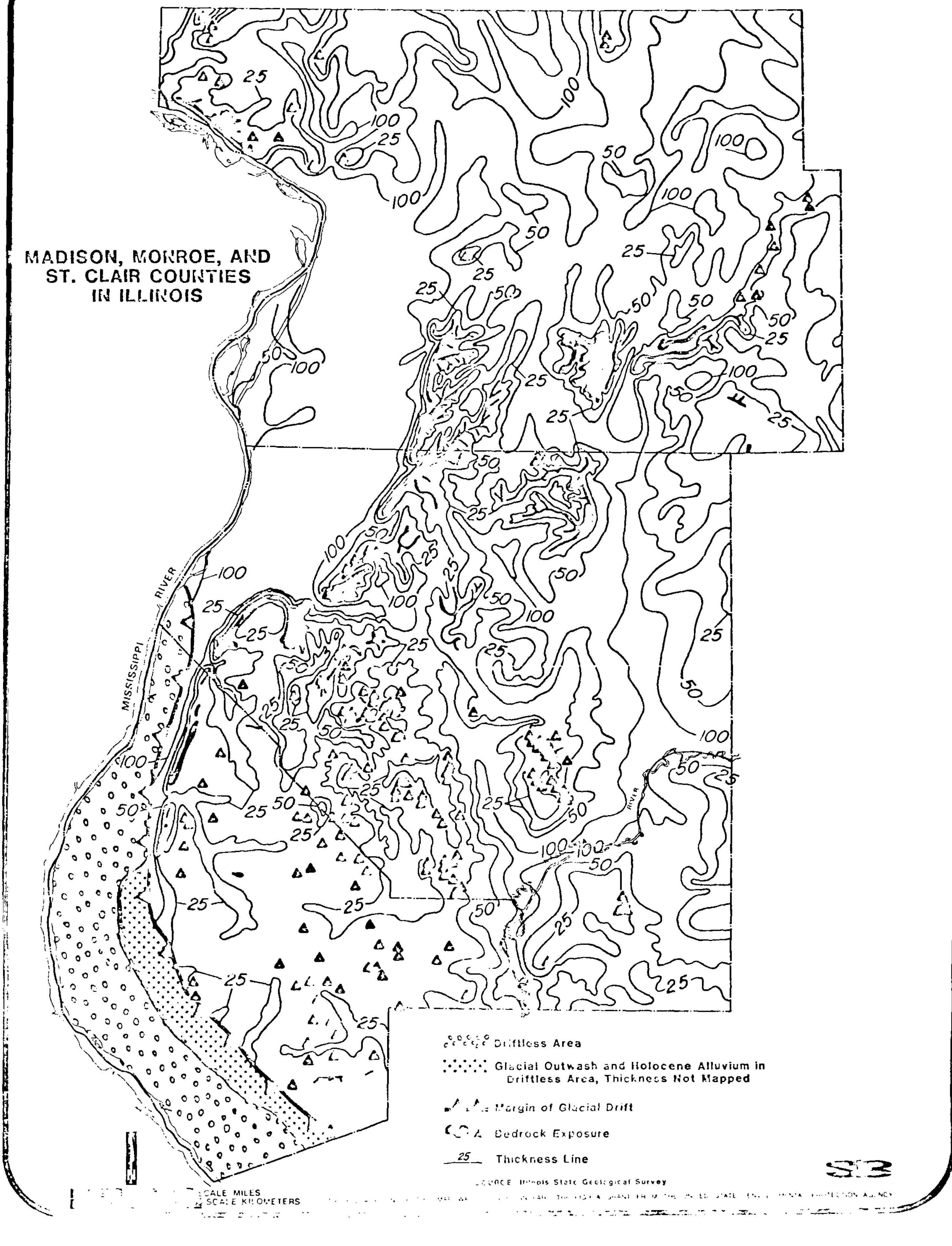
permeability and consist mainly of shales, sandstone, thin limestone and coal. The water-yielding character of these formations is variable but generally very low. The only formations that yield any appreciable amounts of water in these rocks are the sandstones. Because the sandstones differ laterally in permeability, they are not water-yielding at all sites. The chances of obtaining a well in the Pennsylvanian aquifers yielding more than 20 gpm are poor (see Figure 4). In addition, as the depth of the aquifer increases the water's mineral content also increases. As a result, the use of groundwater from these formations is extremely limited. Locally, however, shallow sandstone and creviced limestone may yield small supplies of groundwater in areas where drift supplies are inadequate.

Unconsolidated Deposits - The glacial drift, ranging in thickness from 5 to 200 feet, which blankets the bedrock in Southwestern Illinois, was deposited during the Pleistocene Epoch. This later period in geologic history, which is often referred to as the Ice Age, began about one million years ago and was marked by the advance of continental glaciation. Although four major glacial advances covered portions of Illinois, glacial materials in the study area represent deposits left by only the last two advances -- the Illinoian and the Wisconsinan. The Illinoian Till Plain comprises much of the area east of the Mississippi River bluffs. Wisconsinan till is not present within the study area due to the fact that the Wisconsinan ice sheet did not advance into the study area. However, the effects of Wisconsinan glaciation within the study area are extremely widespread in the form of wind and water transported glacial materials. Melting glaciers deposited sand, gravel, silt and clay. After the flooding glacial meltwaters had receded, the glacial materials which had been deposited in the stream valleys became exposed. When these materials had dried, the wind picked up many of the fine-grained sand, silt and clay (mostly silt) sediments and deposited them on the uplands in uniform layers known as loess. Since winds were generally from the northwest, the loess deposits are thicker on the uplands adjacent to the Mississippi River flood plain. The distribution of the surficial materials is shown in Figure 5. The thickness of the glacial drift, which is identified in Figure 6, is highly variable. One hundred plus-foot thicknesses occur in the buried bedrock valley beneath the Kaskaskia River in eastern Monroe and St. Clair Counties as well as the Mississippi River. This drift and exposed bedrock are common in the upland area.

A majority of the available groundwater found in the study area is taken from valley fill materials. Most of the groundwater from valley fill material is withdrawn from the flood plain of the Mississippi and Kaskaskia Rivers. The probabilities for obtaining high yield wells for industrial and municipal uses are favorable in these areas (see Figure 7). High capacity wells reach excellent water yielding sand and gravel deposits at depths of 50 to 75 feet.

Thickness of the Glacial Drift



SOURCE: Illinois State Geological Survey

The Mississippi River flood plain is the dominant source of groundwater recovered from valley fill materials. The valley fill is composed of recent alluvium and glacial valley train material and is underlain by Mississippian and Pennsylvanian bedrock, consisting of limestone and dolomite with subordinate amounts of sandstone and shale. It has an average thickness of 120 feet and ranges in thickness from less than one foot near the bluffs to over 170 feet near the City of Wood River. The valley fill is generally at its greatest thickness at a mid-point between the bluffs and the river. The coarsest deposits most favorable for water development are commonly encountered near bedrock and often average 30 to 40 feet in thickness. Recharge within the area is from precipitation, induced infiltration of surface water from the Mississippi River and small streams traversing the area, and subsurface flow from the bluffs bordering the area.

Groundwater Flow - The direction of groundwater flow is ideally determined from the collection and interpretation of regional water data. This data exists only for the sand and gravel aquifers in the American Bottoms. Only very limited data is available on other aquifers within the study area. The Illinois State Water Survey currently operates a network of 15 groundwater level observation wells in the study area, all of which are in the East St. Louis area. Figure 8 shows their location and Table 2 summarizes the types and periods of record for the water-level data.

Generally throughout the study area groundwater movement in the shallow drift deposits follows the land surface topography, with lateral movement toward local discharge zones (small streams and wells) and some movement into the deeper unconsolidated aquifers. Groundwater in the deeper drift deposits generally follows the bedrock surface. As a result, groundwater generally moves "downstream" through the sand and gravel aquifers in much the same direction as the original streamflow, but at a much slower rate.

Groundwater in the East St. Louis area generally moves slowly towards the west southwest to the Mississippi River and other streams and towards cones of depression created by industries and municipalities. The establishment of industrial centers and the subsequent use of large quantities of groundwater by industries and municipalities has lowered water levels appreciably in the areas of heavy pumping. Historically, the lowering of water levels in the major pumping centers along the Mississippi River has established hydraulic gradients from the Mississippi toward the pumping centers. At times groundwater levels are below the surface of the river at places, diverting appreciable quantities of water from the river into the aquifer by inducing infiltration.

Groundwater Levels - High groundwater levels are a major problem associated with the unconsolidated aquifer located in the Mississippi River flood plain, in particular the East St. Louis area. Contributing to the problem is the fact that groundwater levels in this area have steadily risen since

1957, due in part to the decrease in industrial use of groundwater. Additionally, there has been a significant and sustained rise in groundwater levels since the Mississippi River floods of 1973. The result has been widespread sewer damage, higher concentrations of minerals and chlorides in the groundwater and a greater potential for infiltration of pollutants into the groundwater, in particular pollutants from solid and liquid waste disposal.

Currently a network of approximately 250 private, industrial, and municipal wells is utilized every five years by the ISWS to measure water levels in the American Bottoms. A prezometric map is prepared from the data, and the relationship of water levels to pumpage is observed. In addition to five-year observations, the Survey maintains a network of 15 wells which are monitored monthly. Five of these wells are equipped with automatic level recorders (see Figure 8 and Table 2).

Presently, the U.S. Army Corps of Engineers, St. Louis District, is investigating groundwater flooding and associated problems in the American Bottoms. One alternative being considered by the Corps is controlled dewatering. Other agencies participating in this project are: the Illinois State Water Survey which is developing a model to predict fluctuations in groundwater levels based on the amount of rainfall and/or Mississippi River levels; and the U.S. Geological Survey which conducted a sampling program to provide information on existing groundwater quality.

Potential Yields of Aquifers

Within the study area, the greatest potential yields are found in the sand and gravel aquifers located in the alluvial valley of the Mississippi (American Bottoms) and Kaskaskia Rivers. Potential yields of sand and gravel aquifers in the glacial till plain is sparse. Figure 9 illustrates the potential yields for these sand and gravel aquifers.

A very narrow strip of Mississippi River flood plain near the river is particularly suitable for the development of high-capacity wells. With conditions favorable for groundwater recharge from the river, this narrow strip has an estimated potential yield of 3,000,000 - 5,000,000 gallons per day per square mile (gpd/sq.mi.). With the exception of a narrow band at the foot of the bluffs, excellent groundwater yielding sand and gravel aquifers are also present throughout the remainder of the Mississippi River flood plain. Potential yields from this aquifer range from 300,000 gpd/sq.mi. to 400,000 gpd/sq.mi. That part of the flood plain near the base of the bluffs is less favorable for the development of high-capacity wells than the remainder of the flood plain. The sand and gravel deposits near the bluff are thinner than those closer to the river and are somewhat discontinuous. Wells in this area will yield less than 50,000 gpd/sq.mi. (see Figure 9).

The Kaskaskia River flood plain in eastern St. Clair County has the second largest yield potential in the three counties. The sand and gravel aquifer associated with this flood plain may yield 200,000 - 300,000 gpd/sq.mi. Smaller areas of somewhat lesser yields (150,000 - 200,000) are located further downstream in southern St. Clair County and eastern Monroe County. Little information is available about the thickness, texture, and continuity of the aquifers in the Kaskaskia flood plain. Only two municipalities -- Fayetteville and St. Libory -- obtain their water supplies from wells tapping sand and gravel deposits in Kaskaskia Bottoms.

Small areas with potential yields of 100,000 - 150,000 gpd/sq.mi. are associated with valley-fill deposits in eastern St. Clair and Madison Counties. The best yields are obtained from wells associated with Silver Creek. Only one community -- Alhambra in Madison County -- receives its water supply from wells tapping sand and gravel aquifers along the Silver Creek Bottoms. Prior to its participation in a public water supply district which obtains its water from the Kaskaskia River, the City of Lebanon also had a well in the creek bottoms.

On the vast majority of the upland area, the glacial drift is thin and does not contain sand and gravel deposits which have the capability for yielding significant amounts of water. Aquifers with potential yields of less than 50,000 gpd/sq.mi. are available in the thin glacial deposits of northern Madison County, eastern and southern St. Clair County and in extreme eastern Monroe County. Most of the uplands have been identified by the Illinois State Water Survey as areas where municipal and industrial water supplies are usually obtained from other sources, e.g., the Mississippi River flood plain and the Kaskaskia River.

In the three-county area the most important aquifers are deposits of sand and gravel, particularly the aquifers in the American Bottoms and, to a much lesser extent, in the Kaskaskia River alluvial valley. The bedrock, although in part capable of producing large quantities of groundwater is of negligible importance in the American Bottoms because of the excellent sand and gravel aquifer. The Mississippian rocks (limestone, sandstone, and shale) which underlie the American Bottoms extend into the upland in almost all of Monroe County and to extreme northwestern Madison County. These bedrock aquifers have an estimated potential yield of 50,000 - 100,000 gpd/sq.mi. Karst topography present in these areas dictates that special precautions be taken when constructing wells to avoid polluting the aquifer. The remainder of the upland area is capable of producing less than 50,000 gpd/sq.mi. In many areas of the upland, however, the bedrock is the only groundwater source. Where the drift is thin and underlain by Pennsylvanian rocks limited amounts of groundwater for domestic and farm use can be obtained from shallow sandstones and creviced limestones. As the depth of the aquifer increases the mineral content also increases thereby limiting its use.

Potential availability of additional surface water supplies for Madison, St. Clair, and Monroe Counties is discussed in a 1966 report by the Illinois State Water Survey, Potential Surface Water Reservoirs of South-Central Illinois. This report identified 26 potential reservoir sites in the three-county area, one of which was subsequently constructed -- Holiday Shores Lake on Joulters Creek. The remaining 25 potential reservoirs have a combined net yield of approximately 60.4 mgd when full, based on a 25-year drought recurrence interval. Madison County has 10 potential reservoir sites; St. Clair County, 9; and Monroe County, 6. Approximately 66 percent (40.6 mgd) of this net yield is derived from the 9 potential reservoir sites shown in Figure 10.

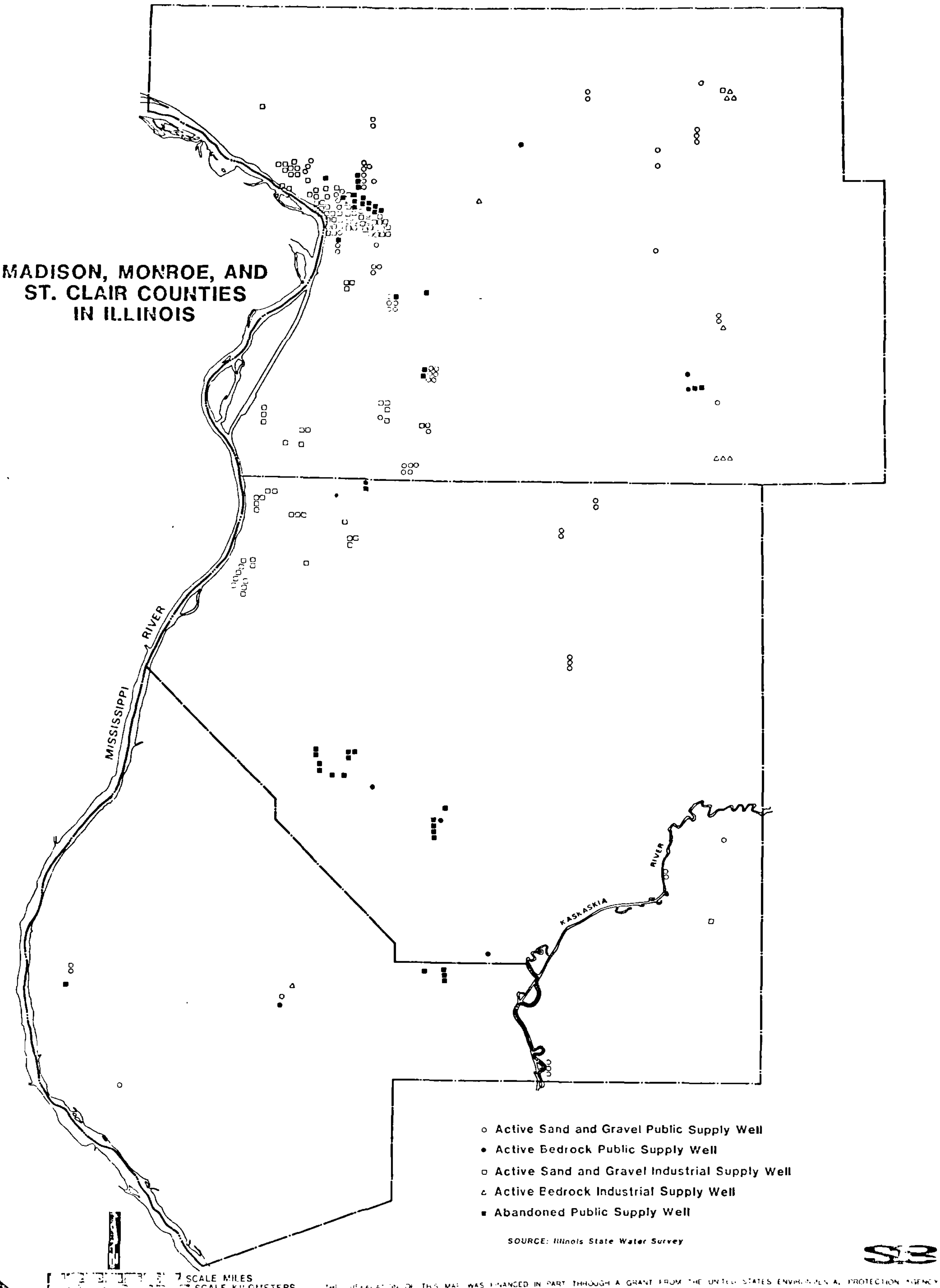
Table 3 summarizes the information for these 9 sites and the results of a comparison of the potential reservoir yields with potential groundwater yields for the same catchment areas. For comparison, the potential groundwater yield was calculated by estimating the potential yield from principal sand and gravel aquifers (Figure 10) in gallons per day per square mile, multiplied by the area of the basin in square miles. For each of the new reservoir sites the potential yield is considerably higher than the potential groundwater yield within each watershed.

1980 Water Withdrawals

Approximately 770 million gallons per day (mgd) was withdrawn for use in Madison, St. Clair, and Monroe Counties. Excluding water drawn from the Mississippi River for electrical power generation the total was considerably lower, about 160 mgd. Groundwater withdrawals accounted for approximately 67 mgd. The locations of public and industrial supply wells and their type of aquifers are identified on Figure 11. With only a few minor exceptions in the uplands, groundwater is pumped from sand and gravel aquifers, primarily the aquifers in the Mississippi River flood plain. Since the 1890s a large number of industries and municipalities have turned to the Mississippi River flood plain as a dependable source of high quality water. Within this flood plain, pumpage is generally concentrated in four major pumping centers: Alton, Wood River, Granite City, and National City. Fairmont City, Monsanto, Caseyville, Poag, Troy, and Glen Carbon are minor pumpage centers. Groundwater pumpage which was 108 mgd in 1966 dropped to 59.7 mgd in 1980. The reason for this substantial decrease can be attributed to industries abandoning groundwater sources and turning to the Mississippi River.

During 1980 groundwater comprised 42 percent of all water withdrawn for use, excluding water that is recirculated for electrical power generation. Of the total amount of groundwater withdrawn, 65 percent was for industrial use, 16 percent was for public water systems, 11 percent for rural domestic supply and 8 percent was used for irrigation and livestock. Twenty municipalities in the three-county area rely on groundwater aquifers as

Location of Public and Industrial Water Supply Wells



SOURCE: Illinois State Water Survey

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Estimated Number of Residences Served by Private Water Systems

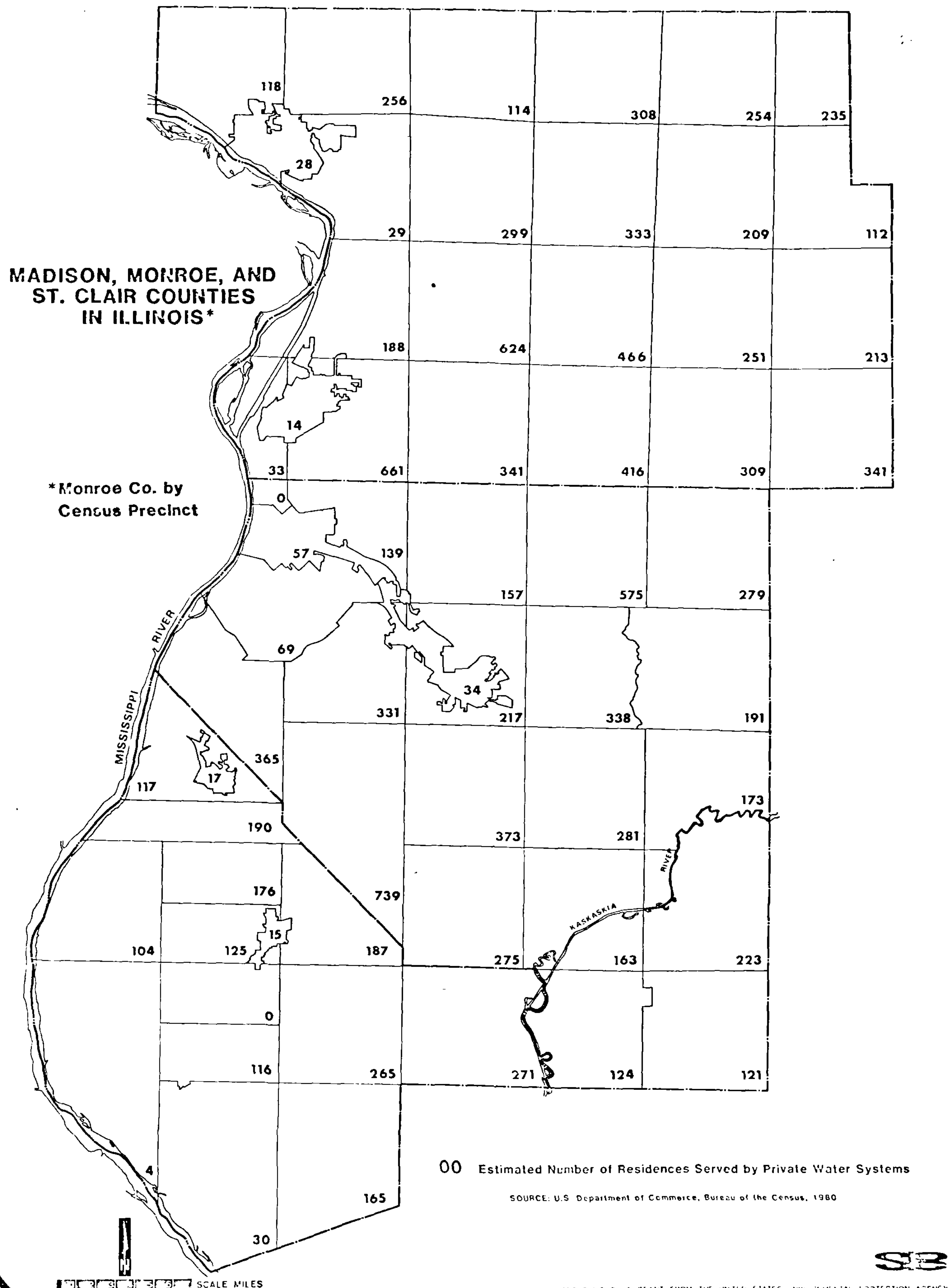

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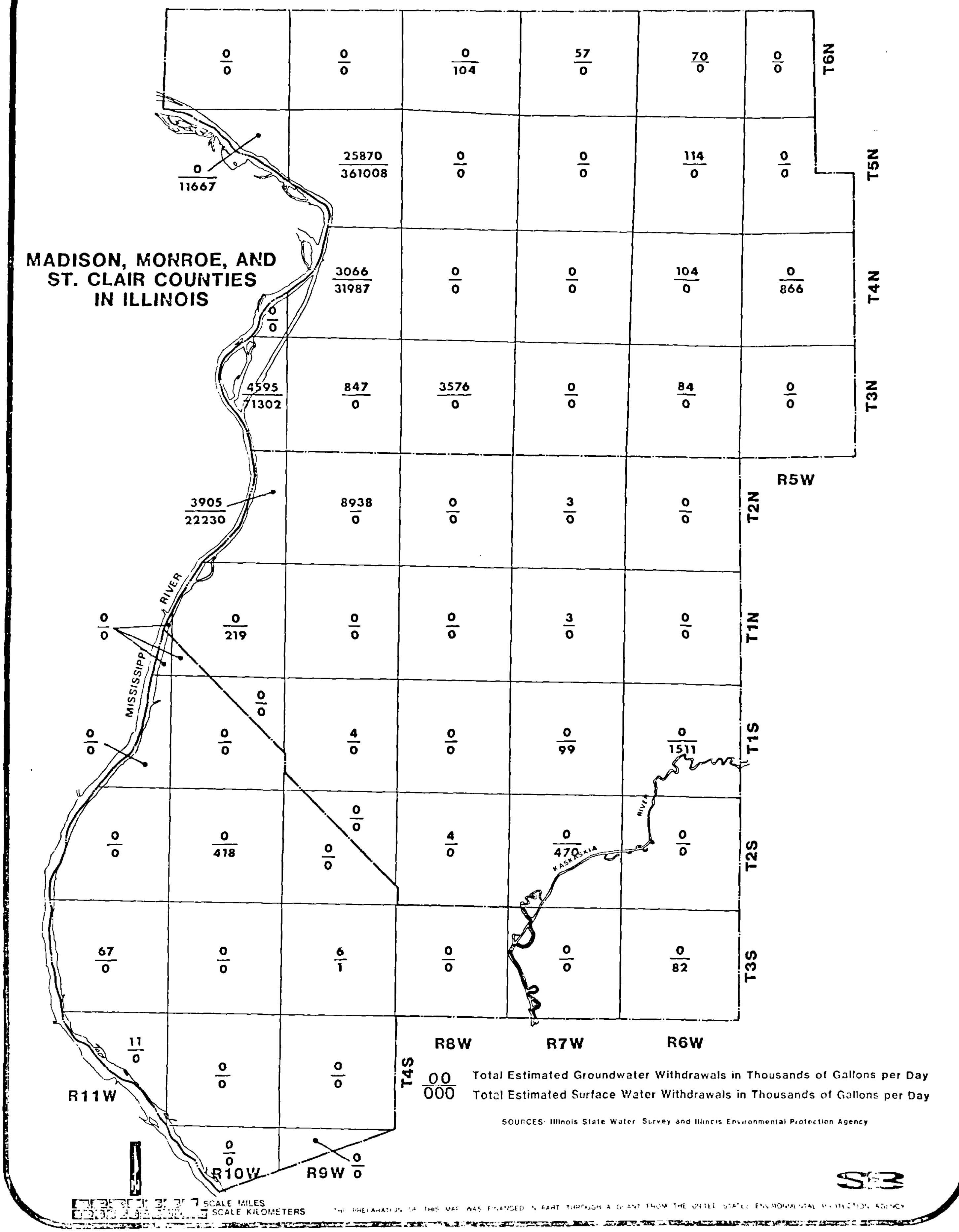
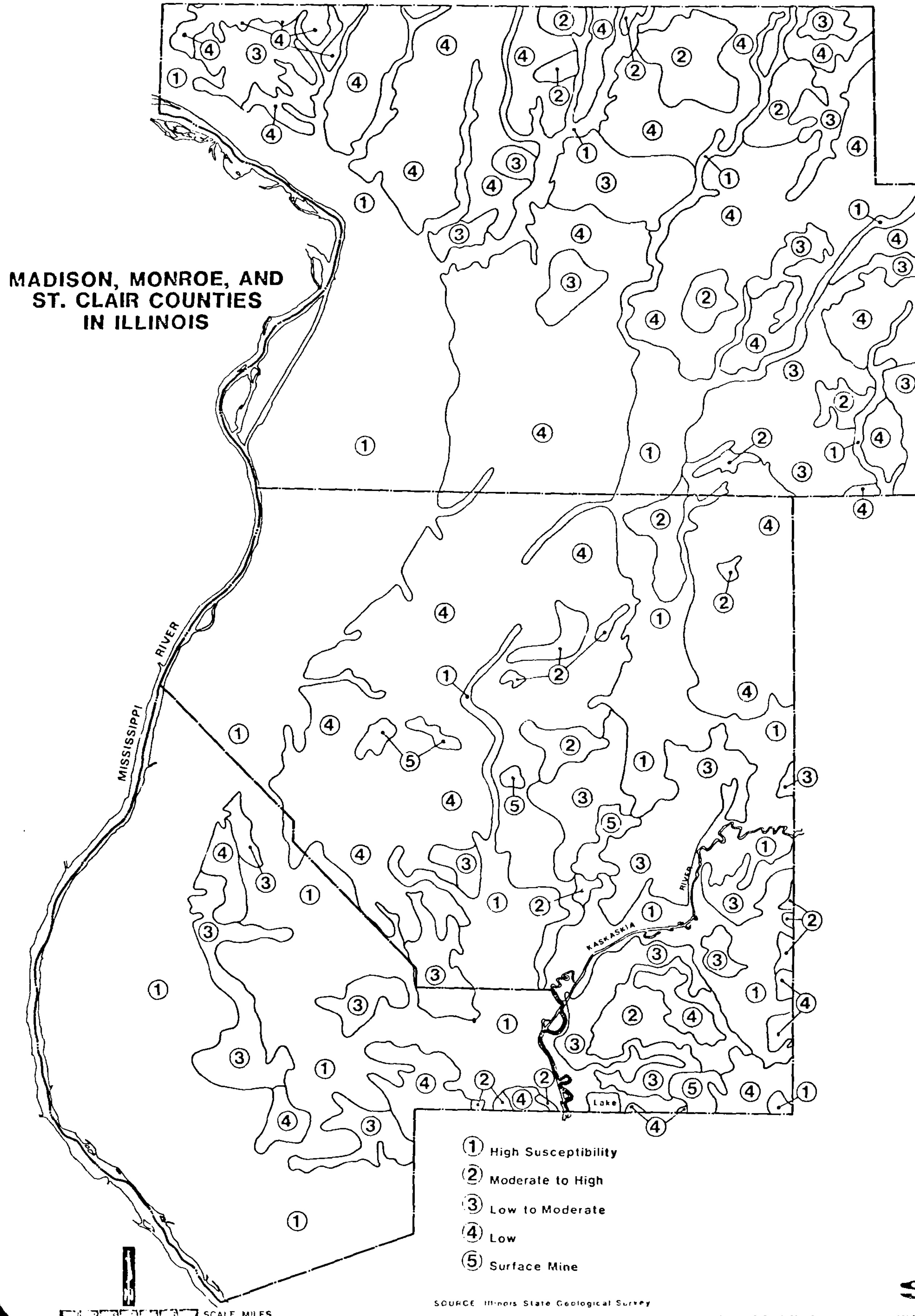
Plate 13

Estimated 1980 Water Withdrawals



Susceptibility of Shallow Aquifers to Contamination From Land Burial of Wastes



SOURCE: Illinois State Geological Survey

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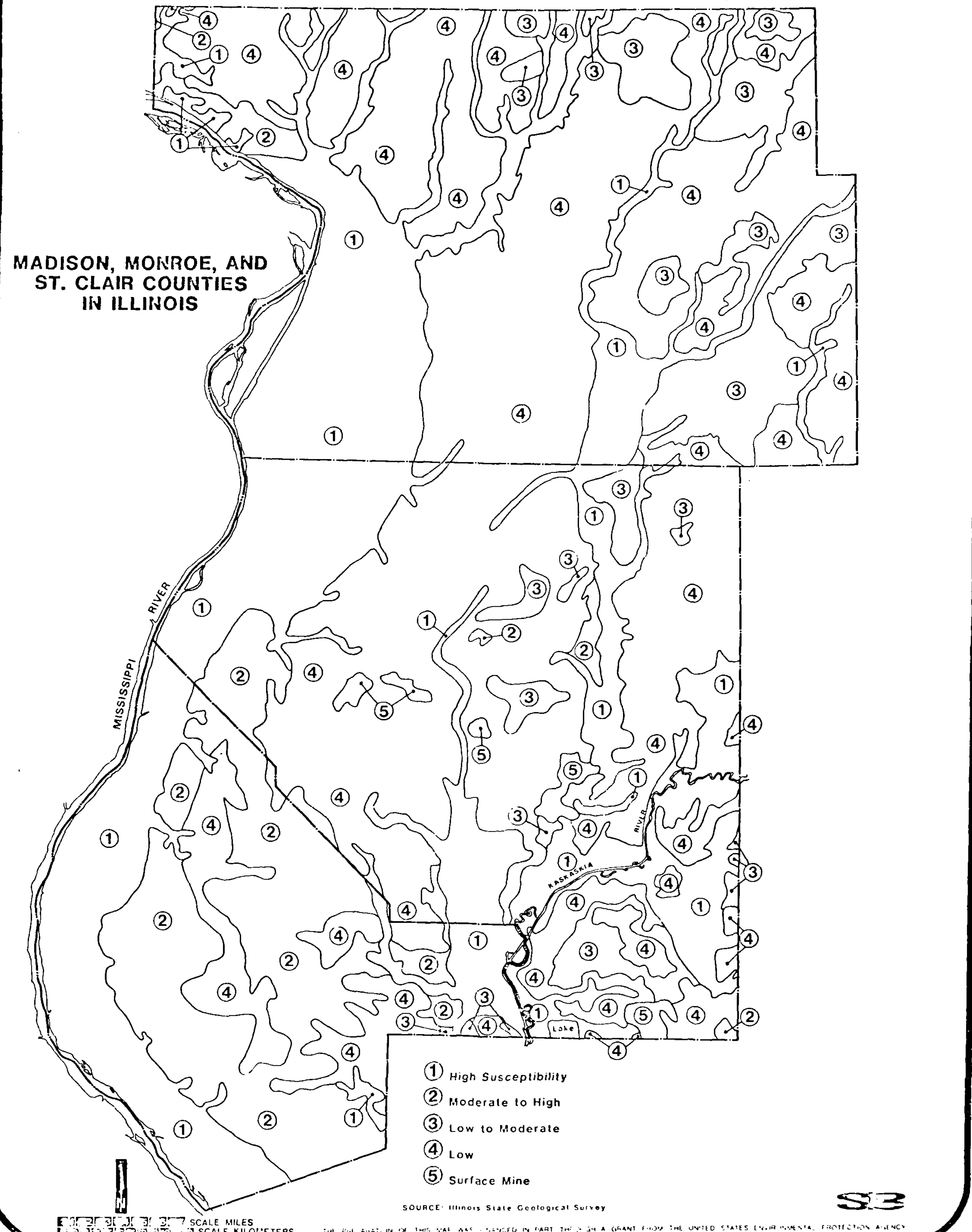
Susceptibility of Shallow Aquifers to Contamination From Surface and Near Surface Waste Disposal



SOURCE: Illinois State Geological Survey

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streams in the region. Areas with moderate to high susceptibility have permeable bedrock generally between 5 and 20 feet of the surface and include the large area of Karst in Monroe County and small areas in Madison and St. Clair Counties. Areas with low to moderate susceptibility have shallow sands and gravels within 20 feet of the surface which are overlain and underlain by relatively impermeable till, other fine-grained material or bedrock. These areas are located in eastern Madison and St. Clair Counties. Areas with the least susceptibility to contamination by surface/near-surface waste disposal have a minimum of 20 feet of uniform till or other fine-grained material at the surface or have relatively impermeable bedrock within 20 feet of the surface, mostly overlain by till or other fine-grained material. These areas are found througout most of the uplands in Madison and St. Clair Counties.

While this classification categorizes materials according to susceptibility to potential contamination, it also rates the materials generally according to potential problems that may limit the operational effectiveness of shallow waste disposal systems and methods. Those materials most highly susceptible to contamination will generally let waste effluent enter easily, and shallow treatment systems, such as a septic system, appear to operate well. The materials least susceptible to contamination, because of low hydraulic conductivities, often do not readily accept waste; acceptance problems may cause septic system failure. The density of septic system units or frequency of application of agricultural chemicals or sewage sludge, topographic considerations and surface soil characteristics may also affect the optimum workability of surface and near-surface waste disposal and their potential to contaminate ground and surface waters. Local soils maps as well as detailed geologic information are often necessary for proper management of this type of waste disposal.[2]

Land Burial of Municipal Wastes - Shallow Aquifers

Figure 18 shows susceptibility of shallow aquifers to contamination by municipal waste disposal by land burial. Those areas most susceptible to contamination are alluvial or have sand and gravel or permeable bedrock within 20 feet of the land surface, and include the American Bottoms area, the Karst area in Monroe County, the Kaskaskia alluvium, and alluvial valleys of smaller streams in the region.

Areas with moderate to high susceptibility have sand and gravel deposits within 20 feet of the surface, overlain and underlain by relatively impermeable till, other fine-grained material, and/or bedrock. These areas are located in eastern Madison and St. Clair Counties.

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[2] Illinois State Geological Survey. Potential for Contamination of Shallow Aquifers in Illinois.

Areas with low to moderate susceptibility have permeable bedrock or sand and gravel overlain and underlain by relatively impermeable till within 20 to 50 feet of the surface. Because land burial trenches are often 20 feet deep, potential aquifers within 30 feet of the bottom of the trench are potentially susceptible to landfill leachate. Overlying materials of low hydraulic conductivities, however, provide some natural protection to the potential groundwater supply. This condition occurs in scattered locations throughout the three-county area.

Areas with the least susceptibility to contamination by landfilling contain either relatively impermeable bedrock within 20 to 50 feet of surface, mostly underlain by till or other fine-grained materials, or have uniform, relatively impermeable sandy till at least 50 feet thick. These zones are generally located throughout the upland areas of Madison and St. Clair Counties.

Deep Aquifers

In most circumstances, the groundwater aquifers most affected by contamination are the shallow, unconfined aquifers near the surface. However, the deeper drift aquifers, while relatively less prone to contamination by virtue of their depth, are also susceptible to contamination from surface and near-surface activities. The deeply buried drift aquifers receive substantial recharge from the overlying shallower deposits. Therefore, the contamination of shallow deposits may precede the contamination of deeper aquifers receiving recharge from overlying formations.

Several factors influence the transport and attenuation of contaminants into groundwater aquifers. Among the most important factors are the texture and composition of the earth materials. Thick sequences of overlying, low-permeability glacial till can impede the rate of recharge, although eventually the surficial deposits will reach the deeper drift aquifers. Fine-grained deposits filter out bacteria and reduce concentrations of some chemical constituents by ion exchange. Clay materials in particular have the capacity of exchanging ions with contaminants in groundwater, thus immobilizing certain contaminant ions and reducing their concentrations in solution. Silts and sands are also able to exchange ions to a limited degree, while sand and gravel and fractured bedrock aquifers generally provided little or not attenuation of either chemical or bacteriological contaminants.

Transport of contaminants to the deeper aquifers can also be accelerated by pumping groundwater from the deep aquifers. The water table is drawn down near the well, creating a cone of depression that surrounds the well. The water table gradient is very steep in the cone, causing rapid movement of groundwater to the deeper aquifer.